

**IN THE UNITED STATES PATENT & TRADEMARK OFFICE****United States Patent Application****For****Mesh Screen Apparatus and Method of Manufacture****By****David Wei Wang and Colin Price-Smith****CERTIFICATE OF MAILING UNDER 37 C.F.R. 1.8 & 1.10**

I hereby certify that this document and its attachments are being sent on the date indicated below to: Mail Stop: Patent Application,  
Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

☐ facsimile to number \_\_\_\_\_

☐ first class mail.

☒ Express Mail: Post Office to Addressee No. EV 337 085 149 US

Date

July 25, 2003

Joanne Hyland

Joanne Hyland

## **MESH SCREEN APPARATUS AND METHOD OF MANUFACTURE**

[0001] This application claims the benefit of U.S. Provisional Application 60/399,254 filed July 29, 2002.

### **Background**

[0002] Field of Invention. The present invention pertains to screens used in subsurface well completions, and particularly to screens using mesh media.

[0003] Related Art. Screens are commonly used in well completions in which the producing formation is poorly or loosely consolidated. Abrasive particulates, generally referred to as “sand” or “fines”, can cause problems if produced. For example, the formation surrounding the wellbore can erode and wash out, potentially leading to collapse of the well. Sand can damage equipment such as pumps or seals as the sand travels at high speed through the pump or past the seals. Produced sand must be disposed of, and this imposes an additional cost to the well operator. Fines can clog flow passages, disrupting production.

[0004] Often, to enhance filtration, a layer of particles of presorted size, commonly referred to as “gravel”, is injected between the formation (or casing) and the screen. In those cases, the screen is sized to prevent passage of the gravel. The gravel in turn prevents the passage of fines.

[0005] Various screen types are used to prevent the production of sand. For example, a perforated base pipe can have wire wrapped around it such that the spacing between the wire wraps limits the size of sand that can pass. Mesh material can also be used. However, manufacturing screens can be an expensive, time-consuming undertaking. Therefore, there is a continuing need for improved designs and manufacturing methods for screens.

### **Summary**

[0006] The present invention provides for a design and method of manufacture

for a mesh-type screen to be used in subsurface well completions to prevent the production of sand.

[0007] Advantages and other features of the invention will become apparent from the following description, drawings, and claims.

### **Description of Figures**

[0008] Figure 1 is a schematic view of a mesh screen apparatus constructed in accordance with the present invention.

[0009] Figure 2 is an exploded view of the mesh screen apparatus of Figure 1.

[0010] Figure 3 is a schematic view of an alternate embodiment of a mesh screen apparatus constructed in accordance with the present invention.

[0011] Figure 4 is a schematic view of an alternate embodiment of a mesh screen apparatus constructed in accordance with the present invention.

### **Detailed Description**

[0012] Figure 1 shows a mesh screen apparatus 10 constructed in accordance with the present invention. Mesh screen apparatus 10 comprises a mesh medium 12 and a perforated base pipe 14 (Figure 2). Mesh medium 12 comprises fiber strands 16, preferably made of metal. In one embodiment, fibers 16 are intermeshed in orthogonal directions to form a layer, and multiple layers are then stacked upon each other. If multiple layers are used, preferably the layers are interlocked.

[0013] A method of producing such an interlocking, layered embodiment of mesh medium 12 is to use needles to punch through the stacked layers of fibers 16. Needles having prongs can be pushed back and forth through the layers, interlocking fibers 16 from different layers. If desired, the resulting blanket of mesh medium 12 can then be formed into a seamless tube, as shown in Figure 1.

**[0014]** Using needles to interlace fibers 16 to make mesh medium 12 allows various porosities in mesh medium 12 to be produced. Porosities commonly range between thirty and ninety-two percent, though other porosities are possible. Fibers 16 of different diameters can also be used to vary porosity. Fiber diameters ranging from two to two hundred microns are commonly used, though the present invention is not limited to those diameter fibers. In this embodiment, as before, fibers 16 preferably interlock among layers. Larger diameter fibers 16 allow for larger porosities. Various diameter fibers 16 can be used in the same mesh medium 12 to produce a mesh medium 12 having variable porosity.

**[0015]** The thickness of mesh medium 12 generally ranges from 0.125 inches to 0.25 inches, but is not limited to that range. Optionally, to make the mesh medium 12 more resistant to collapse, one or more pieces of standard mesh 18 can be placed between certain layers of mesh medium 12, as shown in Figure 1.

**[0016]** In the embodiment shown in Figure 3, mesh screen apparatus 10 surrounds only a portion of base pipe 14. The ends of mesh medium 12 may be secured directly to base pipe 14, or otherwise secured to cover openings 20 (Figure 1) in base pipe 14. The partial covering is to accommodate other structures such as transport tubes 22 or control lines 24 running longitudinally along base pipe 14. Transport tubes 22 are used to provide alternate paths for fluid used in treatments such as gravel packing, fracturing, or acidizing. Examples of control lines 24 include electrical, hydraulic, fiber optic, and combinations thereof.

**[0017]** Note that the communication provided by the control lines 24 may be with downhole controllers rather than with the surface, and the telemetry may include wireless devices and other telemetry devices such as inductive couplers and acoustic devices. In addition, control line 24 itself may comprise an intelligent completion device as in the example of a fiber optic line that provides functionality, such as temperature measurement, pressure measurement, and the like. In one example, the fiber optic line provides a distributed temperature functionality so that the temperature along the length of the fiber optic line may be determined.

**[0018]** The embodiment of Figure 3 also includes intelligent completion devices 26 such as gauges, sensors, valves, sampling devices, a device used in intelligent or smart well completion, temperature sensors, pressure sensors, flow-control devices, flow rate measurement devices, oil/water/gas ratio measurement devices, scale detectors, actuators, locks, release mechanisms, equipment sensors (e.g., vibration sensors), sand detection sensors, water detection sensors, data recorders, viscosity sensors, density sensors, bubble point sensors, pH meters, multiphase flow meters, acoustic sand detectors, solid detectors, composition sensors, resistivity array devices and sensors, acoustic devices and sensors, other telemetry devices, near-infrared sensors, gamma ray detectors, Hydrogen sulfide (H<sub>2</sub>S) detectors, carbon dioxide (CO<sub>2</sub>) detectors, downhole memory units, downhole controllers, perforating devices, shape charges, firing heads, locators, and other downhole devices. In addition, control line 24 may comprise an intelligent completions device 26 as in the example of the fiber optic line that provides functionality, such as temperature measurement, pressure measurement, and the like. In one example, the fiber optic line provides a distributed temperature functionality so that the temperature along the length of the fiber optic line may be determined.

**[0019]** A base pipe 14 having structures attached thereto can also have mesh medium 12 placed such that mesh medium 12 encloses both base pipe 14 and the attached structures.

**[0020]** Mesh medium 12 can also be used to wrap and protect a piece of equipment, such as an electrical submersible pump 27 (see Figure 4). Mesh medium 12 can partially or completely enclosed pump 27.

**[0021]** A method of manufacture of mesh screen apparatus 10 as contemplated under this invention is to slide a pre-fabricated tubular form of mesh medium 12, produced as described above, over base pipe 14, as indicated by the arrow in Figure 2. Base pipe 14 is a conventional tubing having openings 20 such as perforations or slots, as is well known in the art. Base pipe 14 can have an inset portion 28 (Figure 3) to accommodate transport tubes 22 or control lines 24.

**[0022]** Although only a few example embodiments of the present invention are described in detail above, those skilled in the art will readily appreciate that many modifications are possible in the example embodiments without materially departing from the novel teachings and advantages of this invention. Accordingly, all such modifications are intended to be included within the scope of this invention as defined in the following claims. It is the express intention of the applicant not to invoke 35 U.S.C. § 112, paragraph 6 for any limitations of any of the claims herein, except for those in which the claim expressly uses the words 'means for' together with an associated function.